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The Effect of U_3O_8 Powder on the Sintered Density of UO_2 Pellet I. Oxidation Temperature

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1. Introduction

UO_2 is the most widely used nuclear fuel for current nuclear power generation. In addition, the dependence of nuclear power in the total power generation is growing due to eco-friendly factors, such as the regulation of CO_2 emissions. Because of the limitations of uranium reserves and an increasing use of uranium resources, uranium price is increasing. The recycling of uranium resources is environmentally friendly as well as economical.

During the manufacturing process of UO_2 pellets, the accompanying amount of scrap is approximately 8%. These scraps under an air atmosphere at constant temperature are recycled into U_3O_8. In general, the sintered density of UO_2 pellet decreases and pore becomes coarse by the addition of U_3O_8. In other words, U_3O_8 is a density controller as well as a pore-former

In this study, the influence of U_3O_8 powder, formed by the various oxidation temperatures, on the sintered density of CANDU-type UO_2 pellet was investigated.

2. Methods and Results

CANDU-type pellet(97%TD, ~8um) into a platinum crucible was heated at 4℃ per minute in a muffle furnace and the oxidation time was constant at 10 hours. Oxidation was carried out in the 6 temperature conditions (350, 400, 450, 500, 600, 700 ℃). XRD analysis showed that oxidized powder formed by the oxidation temperature was confirmed as U_3O_8. (Fig. 1)

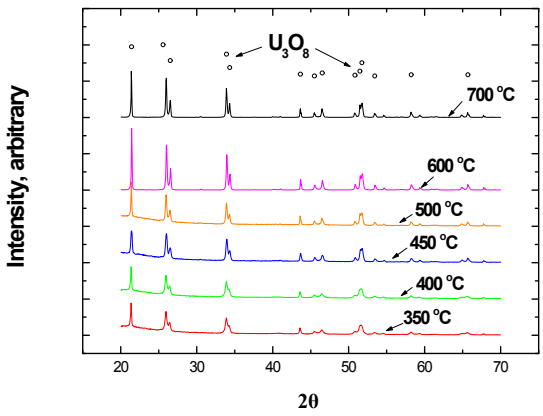

Fig. 1. XRD pattern according to the oxidation temperature

5wt% U_3O_8 powder which is formed by the temperature was added to ex-ADU natural UO_2 powders. Next those powders were mixed for 30 min. in a tubular mixer with 0.2wt% Acrawax for a lubricant. The pressure of compacts was carried out under 3 conditions (150, 300, 450 MPa). The green density was measured by the geometric method. Each density of compacting pressure (150MPa, 300MPa, 450MPa) was estimated as 4.6 ~ 4.7g/cm^3, 5.3 ~ 5.4g/cm^3 and 5.8 ~ 5.9g/cm^3, respectively. The green pellets were sintered at 1700℃ for 4 hours in a H_2 atmosphere. The sintered density of the pellet was measured by an immersion method.

Fig. 2 shows a change in sintered density by the addition of U_3O_8 powder(5wt%) formed by each oxidation temperature.

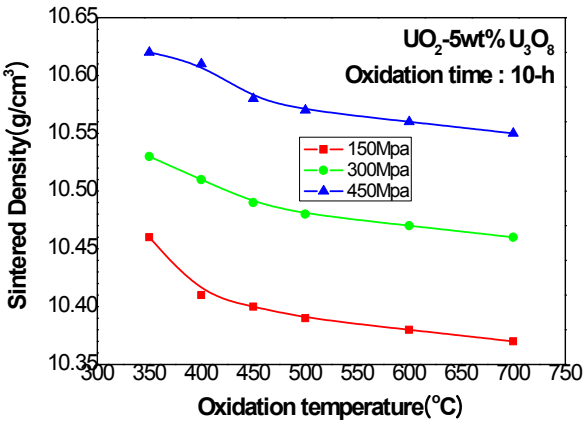

Fig. 2. Sintered density according to the oxidation temperature

As shown in Fig. 2, the sintered density of UO_2 pellet decreases as the oxidation temperature increases regardless of the compacting pressure. This is thought to be caused by the characteristics of U_3O_8 powder that formed by the oxidation temperature. It was reported the higher oxidation temperatures increase the bulk density of the powder but the specific surface is decreased [1]. Namely, it is considered that higher oxidation temperatures cause a coarsening of U_3O_8 particles.

3. Conclusion

- XRD analysis showed that oxidized powder that was oxidized from 350℃ to 700℃ was confirmed as U_3O_8.

- Increasing of the oxidation temperature of U_3O_8 powder causes decreasing of the sintered density of UO_2 pellet.

REFERENCES

[1] S.H. Na et al., Proc. of the Korean Radioactive Waste Society, Autumn 2011, Jeju, 9(2) 2011, pp.163-164